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~~SECRET~~

~~SECURITY INFORMATION~~

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COUNTRY: USSR

SUBJECT: Analysis of Soviet Electrolytic Condensers

DATE OF INFO: [redacted] 50X1

DATE ACQUIRED: Unknown

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ELECTROLYTIC CONDENSERS

A. GENERAL

Our examination of these electrolytic condensers of various ratings has shown that they have good low temperature characteristics and that their construction is simple and probably inexpensive.

The low temperature characteristics are compared in Table I with typical characteristics of American low temperature condensers. It will be seen from this table that the test condensers compare very favorably with only three exceptions (2938, 3557 and 1348). It is probable that these three condensers were not intended for low temperature use.

A number of the condensers were torn apart and examined. The pertinent information is contained in Table II. The following facts appear to be significant:

1. Anodes: The etch anode foils all had a considerably lower etch ratio than is normally found in American condensers. This should contribute to the improved low temperature characteristics. Samples of the foil are currently being analyzed for purity.

2. Paper: Total paper spacer thickness was in all cases much greater than is used in American condensers. Section B which follows, based on samples of the paper, describes it as similar to a kraft paper which had received only a mild mechanical processing. This would lead to a more absorbent paper with poorer mechanical strength which possibly necessitates the additional thickness. Whether or not the fact that the paper is more absorbent is significant to the good low temperature characteristics cannot be stated definitely. Increased absorbency is certainly advantageous, but the increased thickness required could negate this advantage.

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3. Electrolyte: Due to the good low temperature characteristics, it was decided to investigate the electrolyte. This work is reported in Section C, which follows. Briefly, glycerine, nitrogen and borate ion have been found present. There is apparently no ammonia or phosphate ion present. Dissolved in water, the electrolyte tests alkaline. Thus far no cation has been found. There is a possibility of an amine being present.

Since it is apparent that the electrolyte is the most important single factor contributing to the good low temperature characteristics of these condensers, this work is being pursued further.

4. Construction: In all cases the construction was very simple and probably very inexpensive. All the cans were aluminum, and the sections were held firmly in the can by either black wax or paper wadding. Occasionally, the anodes appeared to have been cut out by scissors. Anode leads were either plain foil stitched to the anode or a cut-out and folded extension of the anode itself. Cathodes were all plain foil 0.001" thick, comparable to American practice.

Condenser 2939, although a single capacitance unit, had two different anodes connected in parallel. This is possibly significant in that it may indicate a lack of sufficient facilities to process a single wide anode (principally insufficient generator capacity in the formation process). An alternate explanation would, however, be that there temporarily existed a surplus of the foil width actually used.

Apparently three manufacturers or manufacturing units are represented. Differences between condensers made by each are not great and involve only such things as type of plastic used for cap, method of seal and the like. In general the construction was very similar from one to another.

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B. PAPER

Three papers were rinsed with distilled water and dilute acid to remove electrolyte, then disintegrated and examined microscopically with the aid of various staining solutions. Two of the papers received were 3-5/8" wide, one being 2.5 mils, the other 4.5 mils thick, while the third was 7/8" by 4.5 mils. To represent American practice, a sample of Benares hemp paper (electrolytic) and one of capacitor kraft were similarly processed for comparison purposes. In proportion to their thicknesses, both were much stronger than the unknowns, especially when wet.

The three unknown papers appear to have been made from the same type of fibers, probably a lightly cooked coniferous kraft pulp. This pulp received only very mild mechanical processing (beating), as there is a low proportion of small fragments and fibulated material, while the average fiber is still fairly long, about 1 mm. Retention of many morphological characteristics is further evidence of mild mechanical and chemical treatment.

In comparison to this, the Benares paper which is used in American electrolytics is made from a highly beaten pulp.

Notes:

1. Identification of the unknown fibers as coniferous kraft is somewhat tenuous, since the kraft pulp used for comparison was so highly beaten that few structural characteristics could be determined. The iodine containing stains ("C" Stain and Herzberg Stain) gave confusing results, both with the unknown and the known samples.

2. Two other stains (Bright and Loften-Merritt) showed the unknown fiber to be only lightly cooked and to contain appreciable lignin.

3. Reactions to staining materials might possibly be affected by earlier long immersion in electrolyte, particularly if under electrical or thermal stress.

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4. A "library" of known, typical pulps should be obtained for use in future problems of this sort.

5. Although no commercial paper resembling the unknowns can be cited specifically, it is probably that such a paper could be made rather cheaply, freedom of the pulp from undesirable ions being the only prerequisite which might be difficult.

C. ELECTROLYTE

Unit #3554, reported to be the best, was opened to obtain samples of the electrolyte. A small amount of a solid waxy electrolyte could be obtained at each end of the section and in the mandrel hole.

Using the Hg pool method, the melting point of this material was 130°C, the boiling point 154°C. The sample piece diminished considerably in size prior to melting, as though it were subliming. When burned, an odor similar to that of a burning candle was noted, and as burning progressed, a sweet sugar-like odor was given off. The material chars leaving a crumbly residue, black on the outside and brown interior.

The material is easily soluble in water at room temperature.

No NH_3 is given off when the material is treated with hot NaOH, thus eliminating the presence of an NH_4 compound. Glycerine was present by acrolein test, and borate was present by turmeric test. Nitrogen was found present by $Mn(NO_3)_2$-$AgNO_3$ benzidine test. This may indicate the presence of an amine. Phosphate was absent by molybdate test.

Work will be continued in which the presence of other polyhydroxy alcohols will be investigated, and samples of foil will be analyzed for iron and copper.

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D. FUTURE WORK

Life tests are being conducted on a number of the capacitors at 65°C, and to date no failures have been observed (about 450 hours test). When the 500 hour point is reached, the temperature will be increased with voltage derating to obtain additional information.

Analytical studies on the electrolyte and foil are being continued.

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TABLE I

CONDENSER	RATING		ROOM T		-20°C		-40°C		-50°C		-55°C		ETCHED OR PLAIN
	C	V.	%C	P.F.	%C	P.F.	%C	P.F.	%C	P.F.	%C	P.F.	ANODE
3551-4	5	450	100	2.7	93	13.2	80	73.1	50	92.3	21	93.4	ETCHED
3552-2	10	300	100	2.9	93	14.5	83	61.6	60	88.9	34	94.1	"
3553-1	5	300	100	9	86	19.4	73	75.7	48	94.2	20	95	"
3554	5	250	100	2.6	94	6.98	84	35.3	67	75.3	41	90	PLAIN
3555-2	10	450	100	2.33	93	9.3	84	48	64	83	37	92	ETCHED
3556-1	10	400	100	5.5	90	12.8	69	87	40	96	15	96	"
3557-3	10	150	100	6.98	82	39	47	90	17	96	4	92	"
2938-5	20	450	100	8.4	83	62	28	97	×	×	×	×	"
2939-1	40	450	100	6.7	96	12.3	83	70	49	93	18	94	"
2940-3	40	450	100	3.5	96	9.9	86	63	65	91	35	95	"
1348 (CIA)	100	30	100	17.6	71	71	46	98	14	99	×	×	"
1349 (CIA)	?	400	100	10.5	84	16	75	66	59	96	30	98	"

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CONDENSER	RATING		ROOM T		-20°C		-40°C		-50°C		-55°C		ETCHED FOIL PLAIN ANOD
	°C	V	%C	P.F	%C	P.F.	%C	P.F.	%C	P.F.	%C	P.F.	
AMERICAN *		400 TO 450	100	2.5	91	25	60	88	22	93	—	—	ETCHE
AMERICAN *		300	100	—	86	14	73	63	—	—	—	—	ETCHE
AMERICAN *		100 TO 350	100	—	91	—	66	—	42	—	—	—	PLAIN

* TYPICAL CHARACTERISTICS OF COMMERCIAL JAN [redacted] CONDENSERS. (AMERICAN)

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